University of Pune

M.Phil. syllabus for Zoology

Course structure: Paper I is compulsory

Paper II is compulsory

Paper III is elective (any one subject to be opted by choice)

Total credits to be completed during the course work : 8

Paper I: Research Methodology (2 Credits)

UNIT I: INTRODUCTION OF RESEARCH METHODOLOGY: Meaning of research, objectives of research, types of research, significance of research.

Research Design**:** Meaning, need and features of good research design, types of research designs, Basic Principles of Experimental Designs, Design of experiments.

Sampling Designs**:** Census and Sample surveys, Different types of sample designs, characteristics of good sample design. Techniques of selecting a random sample.

UNIT II :Data Collection**:** Primary and secondary data. Methods of collecting primary and secondary data.

Hypothesis**:** Definition, testing of hypothesis, procedures of hypothesis testing, flow diagram for hypothesis testing, Parametric and non-parametric tests for testing of hypothesis, Limitations of tests of hypothesis.

UNIT III: DATA PROCESSING AND ANALYSIS

Biostatistics: Correlation Co-efficient; simple linear regression, student `T' test; chi -square test, `F'test; ANOVA – one way; two way and multiple way;

Computer science

Introduction to computers and their application in Biology : Operating System (WINDOWS – WORD, EXCEL, POWERPOINT) COMPUTER NETWORKS AND WORLD WIDE WEB – Internet – E-Mail. Biological Databases – Database Management system – Information retrieval – use of computer for statistical analysis.

UNIT IV: RESEARCH METHODS AND THESIS WRITING:

Identification, selection and scope of research problems – methods of literature collection and review – planning and execution of investigation – Thesis writing – preparation and presentation of research papers for journals, conferences – preparation of short communications and review articles.

References

1. Anderson, Durston &Polle 1970: Thesis and assignment, writing Wiley Eastern Limited
2. Bier, 1959: Electrophoresis -theory, methods and applications, Academic Press, London, New York.
3. Reverjdege B, 1979: The art of Scientific Investigation W.E. Norton and Co., New York.
4. Block, R. I. Durram E.K. and Eweig,G, 1956: A manual of paper chromatography and electrophoresis. Academic press, New York.
5. Chayan J & Butcher R.G, 1973: Practical histochemistry, Willey Interscience Publication, London.
6. Clark G.L, 1961: The Encyclopedia of microscopy, Reinhold publishing corporation, New York.
7. Fisher R.A, 1950: Statistical methods of research workers.
8. Freund J E, 1967: Modern elementary statistics, Prentice Hall, Inc. Englewood cliffs, N J.
9. Malter K, 1972: Statistical analysis in Biology, Chapman Hall, London.
10. Campbej R C, 1975: Statistics for Biologists IInd Ed. Cambridge University Press, London.
11. Freund. J E Livermore P.E. and Irwin M, 1960: Manual of experimental statistics. Prentice Hall Inc. Englewood, cliff, N.J.
12. Haftman E, 1967: Chromatography, Reinhold publishing corporation, New York.
13. Jones R M 1966: Basic microscopic techniques, University of Chicago Press, Chicago.
14. Lenhoff E, 1966: Tools in Biology, Macmillan Co., New York.

PART – II: RECENT ADVANCES IN ZOOLOGY (3 Credits)

UNIT I: Biochemistry

Vander – Waal's equation - hydrogen bonding and hydrophobic interaction; primary structure of proteins and nucleic acids; conformation of proteins of polypeptides (secondary, tertiary, quaternary and domain structure) reserve turns and Ramachandran plot, structural polymorphism of DNA, RNA and three dimensional structure of tRNA; structure of carbohydrates, polysacharides, glycoproteins and peptidoglycans. Lipids and their biological significance.

UNIT II: MOLECULAR BIOLOGY

The law of DNA constancy and c-value paradox, Central dogma of molecular biology, Regulation of gene expression in Prokaryotes and Eukaryotes; Operon Concept; Environmental regulation of gene expression. DNA methylation, DNA damage and repair, Oncogenes and cancer.

UNIT II: IMMUNOLOGY

Antigen, Structure and functions of different classes of imunoglobulins and generation of immunological diversity; Humoral and cell – mediated immunity, primary and secondary immune response lymphocytes and accessory cells.; MHC, Complement fixation.

UNIT III : ENVIRONMENTAL POLLUTION

Different types of pollutant – acute and chronic toxicity; Bioassay LC_{50} values environmental pollution and their impact on animals – Biomagnification – Detoxification mechanism; synergistic and antagonistic effects of pollutants – microbial and environmental degradation of pesticides. Environmental Impact Assessment.

UNIT II : CELL BIOLOGY

Structure and organization of membranes, Glycoconjugates and proteins in membrane systems; ion transport, Na/K ATPase; molecular basis of signal transduction in bacteria, plants and animals, model membranes; liposomes; principles and application of light, phase contrast, fluorescence, scanning electron microscope fixation and staining.

UNIT IV: BIOTECHNOLOGY

Cell and tissue culture in plants and animals; primary culture; cell clones; callus cultures; somaclonal variation; micropropagation, somatic embryogenesis; Haploidy; protoplast fusion and somatic hydridization; hybrids; Gene transfer methods in plants and animals; transgenic biology; Allapheny; Artificial seeds; hybridoma technology. Principles and techniques of nucleic acid hybridization and cot curves; sequencing of proteins and nucleic acids; southern, Northern and South – Western blotting techniques, polymerase chain reaction; methods for measuring nucleic acids.

Paper – III (Optional paper) (3 Credits)

1. INSECT PEST CONTROL AND TOXICOLOGY

UNIT – I

Insect pests, Types of Damage to Plants by insects, Pest surveillance and forecasting pest Outbreak, Assessment of insect population, Estimation of damage caused by insect pests to crops.

UNIT – II

Insect pest control – Natural control – Biological methods, Microbial methods, Chemical methods, Chemosterilant, Insect attractants, repellents, Antifeedants, Integrated pest control.

UNIT – III

Insecticides, Insecticides formulation, Classifications, Mode of action, Inorganic insecticides, Organic insecticides, Insecticides of Plant Origin.

UNIT – IV

Principles of toxicology of insecticides, General Bioassay of pesticides, Insecticide residues, Resistance of insecticides, Factors influencing effectiveness of insecticides.

UNIT – V

Statistics of Toxicology: Median Lethal Dose – Behren's methods, Graphical method, Rapid approximate method by Huson, Finney's Method, Abbott's method.

REFERENCES:

1. Destructive and Useful Insects. Their Habits and control, Metcalf, C.L. and Flint, W.P (1967)
2. General and Applied Entomology. Nayyar, K.K., Ananthakrishnan, T.N. and David B.V. (1976)
3. Pest Management, Mathews, G. (1979)
4. Toxicology of insecticides- Matsumura (1985)
5. Statistics Workbook for Insecticide Toxicology. Regupathy, A. and Dhamu, K.P. (1990)
6. The Scientific Principles of Crop Protection. Martin, H.
7. Neem for the Management of Crops Diseases (Ed). Mariappan, V
8. Neem and Environment, Vol. I & II (Ed) Singh, P.P. Chari, M.S., Raheja, A.K. and Kraws, W. (1996)
9. Elements of Economic Entomology- Vasantharaj David, B. and Kumarasamy T. (1998)
10. Agricultural insect pests of tropics and their control. Hill D.S.

11. New Technology of Pest control. Ed. C.B. Huggaker.

12. Pesticide application method – Mathews, G (1979)

13. Pest Management, G.M. Mathews (1984)

Paper – III (Optional paper)

2 . ADVANCES IN INSECT BIOLOGY AND PEST MANAGEMENT

UNIT – I:

Biology: Ovarioles and testes follicles, their number in different orders and basic histomorphology :male & female accessory glands, their secretion and modes of sperm transfer and reception (spermatophores & spermathecae) Viviparity&Viviparous insects – factors regulating parthenogenesis and polymorphism with special reference to homoptera: Isoptera and Hymenoptera.

UNIT – II

Ecology: Abiotic & Biotic factors in biology, Abundance & distribution of insects with special reference to diapause. Interspecific and intraspecific interactions with special reference to insect migration & pest out break. Insect life table and its application methods of assessing insect pest/populations – plant resistance.

UNIT – III:

Chemical control of Insect Pests: Classification of insecticides, modes of action of insecticides –Mechanism of insecticide resistance: Chitin inhibitors and their efficacy in pest management: recent trends in pesticide application technology.

UNIT IV:

Non-chemical control and Insect pests: Dynamics of prey-predator interaction and host-parasite/parasitoid interactions, genetic and semi-chemical bases of insect pest control – Neurohormone, Juvenile hormone and Ecdysteroids in insects pest management.

UNIT – V:

Integrated Pest Management (IPM): Principles of IPM programme - its objectives, strategy ,ecological basis towards pesticide application. Systems analysis. Recent trends in IPM.

REFERENCES:

1. The ecology of insect populations in theory and practice – Clark, L.R. Geiger, P.W. Hughes, R.D. and Morris, R.F.
2. The Distribution and abundance of animals – Andrewarthan, H.G. and Brioh I.C.
3. Recent advances in Entomology in India – Ed. Ananthakrishnan T.N.
4. Biological control of Insect pests and Weds – Paul e. Bach
1. Agricultural Insect pests of the tropics and their control – Hill, D.S.
2. New Technology of pest control – Ed. C.B. Huggaker
3. Pesticides application methods – Mathews, G (1979)
4. Ecological effects of pesticides – Perring, F.H. and Mellamby K, (1979)
5. Pest Management: - G.M. Mathews (1984)
6. Basic principles of Insect suppression and Management – E.F. Kipling (1979)
7. Migration and dispersal of insects by flight – C.G. Johnson
8. Insect Ecology – Peter W. Price (1975)
9. Genetic control of Insect pests – G. Davidson (1974)
10. Ecology of Pesticides – A.W.A. Brown (1978)
11. Breeding plants resistant to insects – (1980) F.G. Max R.B. Jennings
12. Introduction to insect pest management (1971) R.L. Metcalf and W.H. Luck man
13. Biological Insect Suppression (1977) H.C. Copal and J.W. Martins
14. Insect Pheromones (1972) M. Jacobson
15. Chemical control of insect behaviour (1977) Shorey H.H. and Kchelvy, J.J.
16. Ecological methods with particular reference to the study of Insect population – TRE Southwood (1975)
17. Development and Physiology of the Oocyte – Nurse cell. Syncytium – Telter W.H. 1975. Advances in Insect Physiology Vol. II
18. Insect Hormones – V.J.A. Novak 1975 Chamoman& Hall
19. Physiology of Insect reproduction – F. Englemann Pergamon Press
20. Comparative Insect Physiology. Biochemistry and Pharmacology – Vols. 1 & 2 & 12 – 1985 Eds. G.A. Kerkut & L.I. Gilbert Pergamon Press.

Paper – III (Optional paper)

3. LIMNOLOGY

UNIT - I

a. Origin of lakes, ponds and estuaries
b. Classification of lentic and lotic environments

UNIT – II

a. Physico-Chemical Character of ponds, lakes and rivers
b. Characteristics of estuarine environment

UNIT – III

a. Productivity and energy flow in the freshwater environment
b. Cycling of nutrients in the freshwater environment

UNIT – IV

a. Pollution of the Freshwater environment and its effects on organisms
b. Water borne pathogens and diseases

UNIT – V

a. A general study of freshwater organisms (Plankton, Nekton & Benthos)
b. Freshwater fisheries of India
c. Major carps of India and recent trends in their culture practices

REFERENCES:

1. Limnology- Charles R. Goldman and Alexander J. Horns 1983, McGraw Hill International Book Co., New Delhi.
2. Elements of ecology and Field Biology- Robert Lew Smith, 1977, Harper and Row Publishers,, New York, London
3. Environmental Protection -Emil T. Chanlett, 1973 McGraw Hill Co., New Delhi
4. Field Biology and ecology- Allend H Benton and William, E Warner Jr. 1976. Tata McGraw Hill Publishing Co., New Delhi.
5. Modern concepts of ecology- H.D. Kumar 197 Vikas Publishing House Pvt. Ltd., New Delhi.
6. Ecology of Freshwater- Alison Leadlay Brown 1971, Heinemann Educational Books Ltd., London.
7. Introduction to Ecology- Papal A. Colinvaux, 1978 John Wiley and Sons, Inc., New York.
8. Environmental Pollution- Mastumura, M. 1972 Academic Press, London
9. Sewage Biology - Metcalf and Eddy 1970 McGraw Hill Co., New York.
10. Water Pollution Microbiology, Ralph Mitchell, 1972. John Wiley & Sons. Inc, New York, London.
11. An Introduction to Freshwater Organisms, A. Tonapi.
12. Fish and Fisheries of India V.G. Jhingran, 1980 Hindustan Publishing Co., New Delhi.

Paper – III (Optional paper)

4. PHYSIOLOGY OF MAMMALIAN REPRODUCTION

Unit- I Reproductive System.
i) Male reproductive system.
ii) Role of epididymis in Male fertility.
iii) Female reproductive System.
iv) Capacitation of spermatozoa in the Female.
v) Birth control- Natural, Artificial and Environmental components.
vi) Ageing and reproductive system.

Unit-II Development and Inheritance.
i) Development during pregnancy.
ii) Biology of Myometrium and Cervix.
iii) Prenatal Diagnostic tests and advantages and disadvantages
iv) Endocrinology of Pregnancy and Parturition, control of parturition.
v) Physiology of Lactation inheritance.

Unit- III Reproductive Technology.
i) Artificial insemination, semen analysis, sperm preparation for ICSI.
ii) Invitro fertilization. (IVF)
iii) Cryopreservation.
iv) H.Y. Antigen and Sex Determination.
v) Pheromones and Reproduction: Signaling, Chemical communication.

Unit-IV Endocrinology and reproduction.
i) Pituitary hormones.
ii) Thyroid metabolic hormones.
iii) Male sex hormones.
iv) Female sex hormones.
Physiological, Biochemical and Molecular Approaches in above (i-iv).
v) Pregnancy and Neonatal Physiology

REFERENCES:

1. Davis A., Blakely A. and Kidd C. 2001. Human Physiology, Harcourt Publishers Limited, Churchill, Livingstone.
2. Elder K. and Dale B. 2000. In vitro fertilization 2nd (Ed), Cambridge University Press.
3. Guyton A.C. 1986. Textbook of Medical Physiology 7th (Ed), W.B. Saunders Company Igaku / Saunders.
4. Guyton A.C. 1992. Human Physiology and Mechanism of Diseases 5th (Ed), W.B. Saunders Company Igaku / Saunders.
5. Kassel R.G. 1998. Basic Medical Histology, Oxford University Press New York.
6. Cradle W., Ketch V. and Ketch F. 1986. Exercise Physiology, Lea and Fibiger, Philadelphia

Paper – III (Optional paper)

5. Toxicology

Unit –I Scope of Toxicology

i) History, Definition, Disciplines of toxicology.
ii) General concept of toxicology.
iii) Toxicants and their classification.
iv) Cardio toxicants, Immunotoxicants : Types, Biochemical and Molecular mechanisms.

Unit –II Environmental pollution and public health

i) Principal consequences of Environmental pollution.
ii) Impact of Air, Water and Soil Pollution on Human Health : Physiological, Biochemical and Molecular components.
iii) Air, water and soil pollution.
iii) Radioactive and noise pollution : Physiological and Molecular interpretation.
iv) Bioaccumulation and Biomagnifications.

Unit –III Toxicological testing methods and Pesticide Metabolism

i) Toxic metals – Principal of metal toxicity, important toxic metals, effect on human kind animals.
ii) Toxicity tests – Based on number and condition, Based on exposure period, Acute toxicity test, chronic toxicity test, toxic effects.
iii) Toxicological testing methods – Behavioral, respiratory, Kidney, Liver, Skin function tests.
iv) Metabolism of Pesticides of following group: Chlorinated Hydrocarbons, O.P., Carbamates, Dinitrophenols, Synthetic pyrethroids and Biopesticides.

Unit – IV Dose-response relationship

i) Selection of doses, Types of dose-response relationship, cumulative response, threshold limit.
ii) Mode of action of toxicants – Protein, Lipid and Carbohydrates at cellular level.
iii) Modifying factors of toxicity of xenobiotic chemical.
iv) Biotransformation of toxicants – oxidation, reduction, hydrolysis, Conjugation reaction.

REFERENCES:

1. Albert,A. 1960. Selective Toxicity, Wiley, New York.
2. Ariens,E.J., Simonies, A.M. and Offermerier, J. 1976. Introduction to General Toxicology.
3. Boyland, E. and Goulding, R. 1968. Modern Trends in Toxicology, Butterworths, London.
4. Butte, G.C. (Ed) 1978. Principles of Ecotoxicology. SCOPE 12,ICUSSCOPE,

John Wiley and Sons, New York.
5. Carsons, R. 1962 Silent Spring. Houghtan Mifflin, Boston .
6. Casarett, L.J. and Doull, J. 1980. Toxicology, A Basic Science of Poisons, 2ed. The Macmillian Co., New York.
7. Duffs,J.H. and Worth Howard, G.J. 1996. Fundamental Toxicology for Chemicals. Royal Society of Chemistry, Cambridge (U.K.).
8. Fairhall, L.T. 1969. Industrial Toxicology, Hafner Publishing Co., NewYork.'
9. Frank C. Lu. 1985. Basic Toxicology (Fundamentals, Target Organs and Risk Assessment). Hemisphere Publishing Corporation,Washington.

PAPER- III : **(Optional paper)**

6. CONSERVATION BIOLOGY

UNIT: - I SYSTEMATIC BIOLOGY

Taxonomy- Definition- Terms and History; Importance of Taxonomy- Species concept- Kinds of species. Zoological classification- Hierarchy of categories : Linean hierarchy, keys and higher taxonomy-Zoological nomenclature- bar coding.

UNIT: II - CONSERVATION BIOLOGY

Introduction to Conservation Biology – Ethical issues of Conservation Biology - The origin of Conservation Biology. Biodiversity – Species diversity- Genetic Diversity- Ecosystem diversity –Population Genetics- Loss of biodiversity- importance of biodiversity – Ethical role of biodiversity – Threats to biodiversity. Economics of biodiversity conservation – sustainable utilization

UNIT : III - CONSERVATION: TOOLS IN ANIMAL CONSERVATION

Conservation Methods - *In situ* and Ex *situ* conservation of Indian animals (Case studies) - Population management -Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) -Tools in Conservation: Interpretation of various data on wildlife – IUCN Redlist categories - GIS – Remote sensing - Landscape model – PVA and CAMP processes.

UNIT IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION

Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy – Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves –– Wildlife management and Animal welfare- Role of NGO's in Conservation.

References :

1. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.

2. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun

3. Caughley, G., and A.Gunn. 1995.Conservation Biology in Theory and Practice. Blackwell Publishers.

4. Clark,, T. W., R. P.Reading andA.L.Clarke 1994.Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.

5. Dobson,A. P. 1996. Conservation and Biodiversity. Scientific American Library, New York,USA.

6. Donovan, T. M., and C.W. Weldon. 2002. Spreadsheet exercises in conservation biology and landscape ecology.Sinauer Associates, Inc., Sunderland, Massachusetts

7. Dyke, F. V. 2002. A workbook in conservation biology: Solving practical problems inconservation. WCB/ McGraw Hill Publishers, Dubuque, Iowa.

8. Gaston, K. J. 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

9. Groom bridge, B.1992.Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.